RESEARCH REPORT

Using Linear Measurement to Tactually Present Primary Science Concepts in Grades 1-3

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Using Linear Measurements to Tactually Present Primary Science Concepts in Grades I - III

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August, 1971

Introduction

Science teaching is identified as one major academic area of study in the school curriculum. Though identified as such, some supervisors and administrators believe that the lack of emphasis in teaching science to visually handicapped children is still evident in many schools. One possible reason is that this area of study is considered much beyond the capabilities of visually impaired children, and for that matter, contributed by lack of teacher's preparation and the scarcity of available materials and tangible aids in science teaching (SECDE, 1970). Many times science teachers will have to adapt available materials and other educational aids or devise means of conveying an idea, imparting skills, knowledge and understanding relevant to childrens' everyday experience (Tennessee School for the Blind, 1970). It is a general acknowledgement that some kind of tangible apparatus is necessary for conveying certain concepts whether or not the student is visually handicapped (Caton, 1969). Because of the scarcity of available tangible aids in the area of teaching science to visually handicapped children, educators, researchers and curriculum specialist recognize the need for more sophisticated tangible educational apparatus (Franks, 1970; Pester, 1971).

Problem

Before tangible educational apparatus for visually handicapped children can be developed, there should be specific guidelines to provide specifications and priorities for aid development (Caton, 1969; Franks, 1970; Pester, 1971). Such guidelines

are being provided through some form of textbook analysis specifying linear measurement using the ruler as frame of reference Caton, 1969; Franks, 1970; Pester, 1971). It is the purpose of this report to explore the use of linear measurement as a frame of reference for tactually presenting a number of primary science concepts. These concepts often are presented pictorially in textbooks and remain outside the experience of the non-vision student since opportunities for direct inspection and interaction are severely limited. This report includes specific concepts presented in three levels of difficulty, including associated vocabulary, aids required, and details of suggested activities.

Procedure

Five textbooks were analyzed in this study. Each textbook was examined by series from grades one through grade three. These series include:

1. Modern Science, Level One, Laidlaw Brothers, 1970.
2. Modern Science, Level Two, Laidlaw Brothers, 1970.
3. Modern Science, Level Three, Laidlaw Brothers, 1970.
4. Today's Basic Science, Level Two, Harper and Row, 1963.
5. Today's Basic Science, Level Three, Harper and Row, 1963.

Each textbook was analyzed by unit areas. Specific concept areas, related vocabularies, activities and other relevant information related to linear measurements were recorded. The data was organized to indicate the sequence and scope of concept development by grade level. It should be noted that one consideration in this analysis of concepts was the use of the ruler as an aid in linear measurement.

Discussion

Six general concept areas were presented in this paper. Examination of the data revealed that only four similar concept areas were found in both series. These important areas were growth of plants, simple machines, air and ice and water. Magnetism which appears only in level two of Modern Science Series was not discussed as a general area. Rather, it was a specific concept under heat and energy. The aquarium was another area that appeared only in level three of Modern Science Series, but was found both in level two and three of Today's Basic Science series.

For purposes of demonstrating the use of the ruler as an aid in linear measurement, modification of these concept areas were presented by frequency of appearance in all three primary grade levels including associated vocabularies, additional aids required, and details of modified suggested activities.

Concept Area: Growth of Plants

Vocabulary		Aids Required	
fertilizer	growth	water	bean seeds
oxygen	measure	four 3-inch pots	ruler
carbon-dioxide	minerals	soil	plastic bag
soil	parts of plants	plants	

	Activities
LEVEL I	
There are many different kinds of plants. Most plants have leaves, stems, and roots.	Observe several kinds of plants growing such as a tree, a flower, a mushroom, and a water plant. Identify the various parts--leaves, stems, and roots. Rulers may be used to compare parts and identify likenesses and differences of leaves, stems, etc.
LEVEL II	
Plants grow in many different places. Plants must have different kinds of roots. Seeds, buds, stems, and roots may be used to start new plants.	Observe plants growing in soil, in water, on water, on rock, on other plants. Use ruler to measure size of roots of plants growing in various places. Collect seeds and fruits of various sizes and kinds. Talk about the depth and place each kind of seed would be planted. Soak some lima bean seeds in water overnight, open a bean, & observe the tiny plant inside. Discuss other ways new plants are formed from buds, stems, and roots.

LEVEL III

Plants need air, water, and sunlight to grow. Most plants make their own food from air, water, and sunlight.	Discuss the things plants need to grow. Place three bean seeds in four 3-inch pots filled with soil. Label and treat each pot as follows: a. Keep in a window and water regularly. b. Keep in a window and water regularly, but keep tightly covered with a plastic bag. c. Keep in a window. Do not water. d. Keep in a dark closet & water regularly. Observe the growth of the plants. Measure and record the growth weekly. Compare the growth and treatment of the plants.

Concept Area: Air

Vocabulary	Aids Required	
expand	ruler	balloons
contract	yardstick	string

	Activities
LEVEL I	
Air has weight.	Suspend a ruler or a yardstick so that it is balanced. Tie an inflated balloon to each end. Let the air out of one balloon. Does the ruler tip? Does this show that air has weight?
LEVEL II	
Air changes in temperature and in the amount of space it takes up.	Blow up a balloon to make it expand. Place it in a freezer. Take out the balloon after a time. Observe it carefully. What changes in the amount of air inside the balloon can you observe? Did the balloon expand or contract?
LEVEL III	
When air is heated it expands. When it is cooled, it contracts.	Have two balloons and place them on bottles. Put one bottle in hot water and the other in ice water. What happens to the balloon in each case? What happens if air is heated? if it is cooled? Compare the sizes of the two balloons.

Concept Area: Ice and Water

Vocabulary		Aids Required	
evaporation	melt	water	perculator
expand	water vapor	glass	ice cubes
contract	liquid	pans	ruler
freeze	solid		

Activities

LEVEL I

Water changes in shape and size.

Fill a glass with water and measure its depth.
Pour the same water into a pan and measure its depth.
How has the depth of the water changed? Why?
Add ice cubes to water and place in a jar. Measure depth. Let them melt. Measure depth.
Compare the measurements. Is water always the same shape and size?

LEVEL II

Water changes from liquid to vapor.
Ice changes from solid to liquid.

Fill a perculator with water and measure its depth. (a pan and hot plate can be used.)
Heat it for 15 to 20 minutes. Let it cool and measure its depth again.
Has the measurement changed? Why?
Get 2 ice cubes from the freezer.
Put them in a dish and measure each side of the two cubes.
What happens to the ice cubes in 5 to 10 minutes?
Does water form on the ice cube?
How does an ice cube change?
How much water did we get from the ice cubes?

LEVEL III

Heat energy can cause matter to change from one form to another.	Put water in an ice tray and measure it. What happens to water when you put it in a freezer for an hour? Does it lose heat energy? Does its temperature change? What happens when water loses enough heat? What happens when ice absorbs enough heat? What happens when water is heated?, cooled?

Concept Area: The Aquarium

Vocabulary		Aids Required	
aquarium	frame	sand	soil
width	snails	water	pebbles
length	fish	plants	black snail
habitat	plants	fish	fish food
		metal frame	

Activities

LEVEL I

An aquarium is a small community of plants and animals.

Discuss what an aquarium is.
Observe an aquarium. What kinds of things are in an aquarium?
How deep is the water?
What size aquarium will you need?

LEVEL II

An aquarium needs to be inhabited in proportion to its size.

Make a list of things you can put in an aquarium.
If you add more plants and fish, what size aquarium will you need?
Discuss the importance of having more space in an aquarium.
Set up an aquarium.
Measure the depth of water.
Measure the depth of the sand.
Measure the lengths and sizes of the fishes, snails, and plants

LEVEL III

A determined size of aquarium would provide a definite idea about the size and kinds of materials needed to set up an aquarium.
An aquarium is a good way to study pond life.

What materials are needed to set up an aquarium?
Discuss the steps in setting up an aquarium.
a. Clean the aquarium.
b. Wash the sand.
c. Place the sand in the aquarium
d. Set the plants in the soil.

e. Place pebbles over the roots of the plants.
f. Fill the aquarium with water about 1 inch from the top.
g. Let the water stand for 2 or 3 days.
h. Add black snail.
i. Add fish.

Gather plants from a pond. Note depth where plants were found in pond.

Arrange in container of pond water at similar depths.

Add fish, snails, and maybe a tadpole from the pond.

Use a ruler to determine amount of movement of each animal in aquarium.

Measure its length and width to determine what size aquarium you will need.

Concept Area: Simple Machines

Vocabulary		Aids Required	
levers	force	bar of wood	book
machine	plank	plank	box
wedge	log	log (2 to 3 feet)	knife or scissors
bar		sticks	sand

Activities

LEVEL I

A bar is a kind of machine.

Lift or push heavy objects without using a bar of wood.
Lift or push the same object by using a bar.
What differences has it made?

LEVEL II

Levers can increase force or reduce the amount of work you do.

Lift a book up.
Pry it up with a 10-inch stick.
Lift it up again using 16 or 18-inch stick.
What difference has it made?
Let us try another one. Lift a big box up off the floor.
Have a plank and a log. Put the box on one end and stay at the other end of the plank.
Push down the plank using both your hands.
What difference has it made?

LEVEL III

A wedge cuts and spreads materials

Have a piece of cardboard, sand and an empty box made of wood.
Put the sand into the box. Cut the piece of cardboard into a wedge about 6 inches long.
Push this wedge through some sand.
Which way does the sand move?
Measure how far the sand is pushed to each side.
Measure how wide the wedge is.
What do you find out about a wedge?

Concept Area: Magnets

Vocabulary		Aids Required	
magnets	electromagnet	magnets	dry cell
attracts	coil	insulated wire	ruler
proportional	insulated wire	various objects (nails, aluminum, etc.)	
objects	dry cell		

Activities

LEVEL I

Magnets attract iron objects.

- Observe a magnet.
- Place various objects of different sizes on the table
- Use a ruler to identify the different sizes of the objects.
- Identify the various objects that are attracted by magnets.

LEVEL II

Magnetic force is proportional to the distance of the magnet to the object it attracts.

- Have a horse shoe and a bar magnet.
- Place a 4 or 5 inch nail on the table.
- Place a magnet at one end of a 1 foot ruler and the nail at the other end. Do they attract each other?
- Move the magnet closer to the nail until it attracts the nail.
- How close was the magnet to the nail before it was attracted?
- Repeat the procedure using the other magnet.
- Compare the power of attraction of the two magnets the distances measured.

LEVEL III

A magnet can be made using electricity. This is called electromagnet.

The strength of the electromagnet is increased proportionally by the increase of current through the electromagnet.

- Have four or five feet of insulated wire, dry cell, and a bar of soft iron such as nails.
- Make a coil of this wire by placing the bar within it. Count the number of turns in a coil.

Connect the end of this wire to the dry cell.
What do you observe?
How strong is the electromagnet?
Increase the number of turns in the coil. Is there any increase in the strength of the magnets?
Compare the results.

REFERENCES

Caton, H. R. Textbook analysis as a technique for identifying tangible mathematical aids for visually handicapped children. Unpublished specialist study, George Peabody College for Teachers, 1969.

Franks, F. L. A conceptual approach to the development of tangible apparatus in mathematics and science. Unpublished report, American Printing House for the Blind, 1971.

Pester, E. J. Primary mathematics textbook analysis. Unpublished report, American Printing House for the Blind, 1971.

Special Education Curriculum Development Center - An in-service Training Approach in Science. A Conceptual program involving the Iowa State Department of Public Instruction and University of Iowa.

Tennessee School for the Blind. Elementary Science Curriculum Guide, 1969-70.